LECHNER
TUDÁSKÖZPONT

National Report of Hungary

István Galambos

EUPOS Council and Technical Meeting
October 30-31. 2019. Budapest, Hungary

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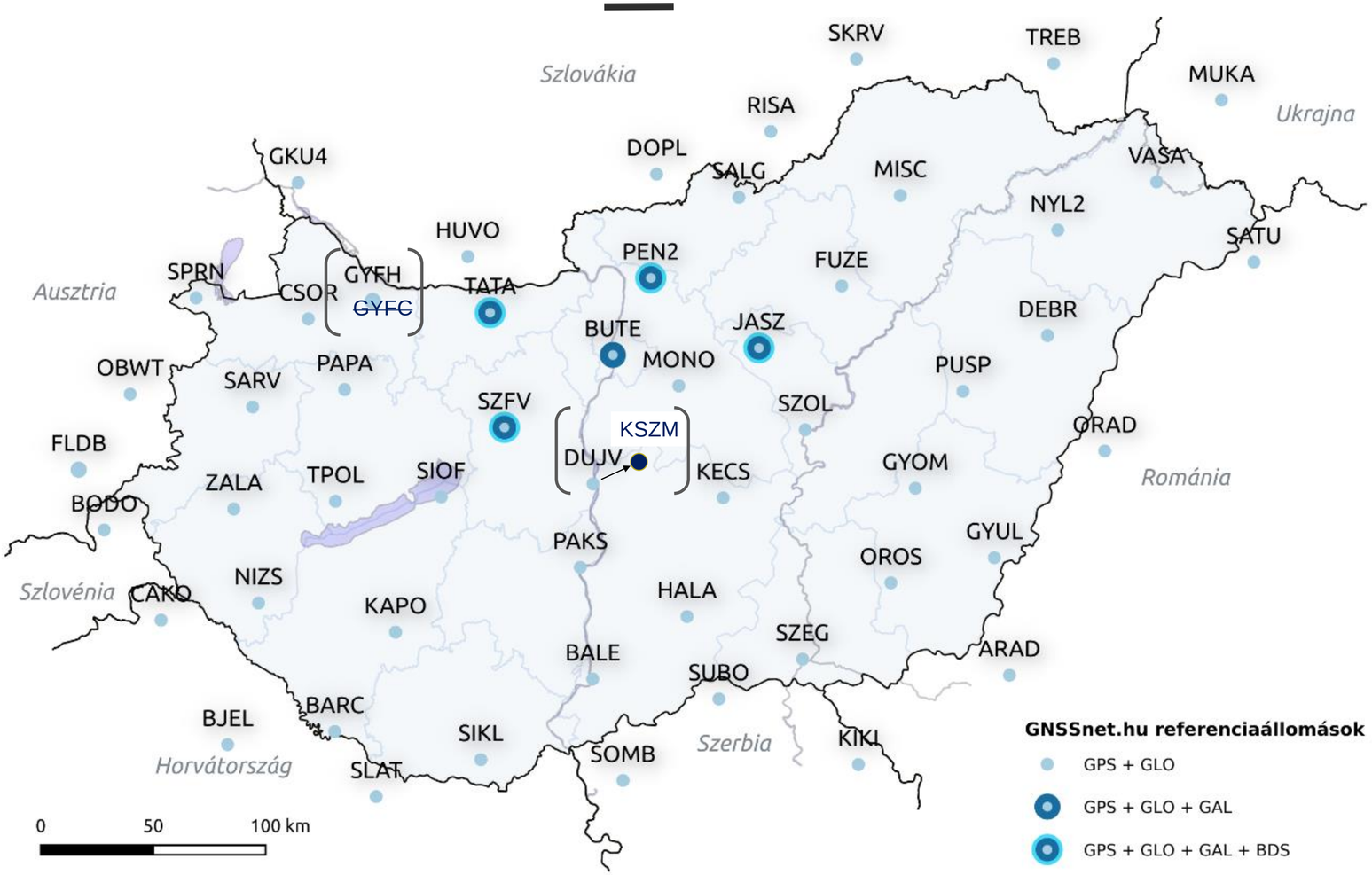
Budapest, Hungary

Reference station network



- *Consists of 54 stations, 35 Hungarian + 19 foreign stations*
- *GYFC relocated within the city >> GYFH*
- *Another station will be moved in the near future*
- *Most stations GPS+GLO capable, except 5 stations near Budapest*

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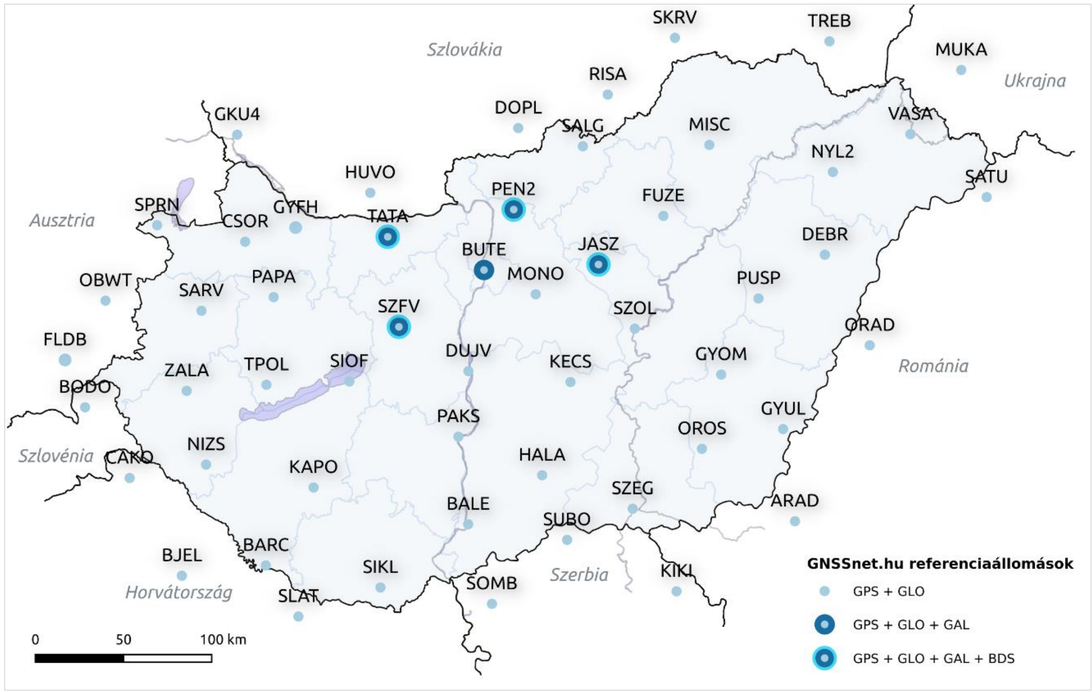
Central processing software: GNSMART-1 (only GPS+GLO)



- *Post processing data: RINEX 2.1*
- *Real time data: max. RTCM 3.1*
- *Still no MSM data in the service*

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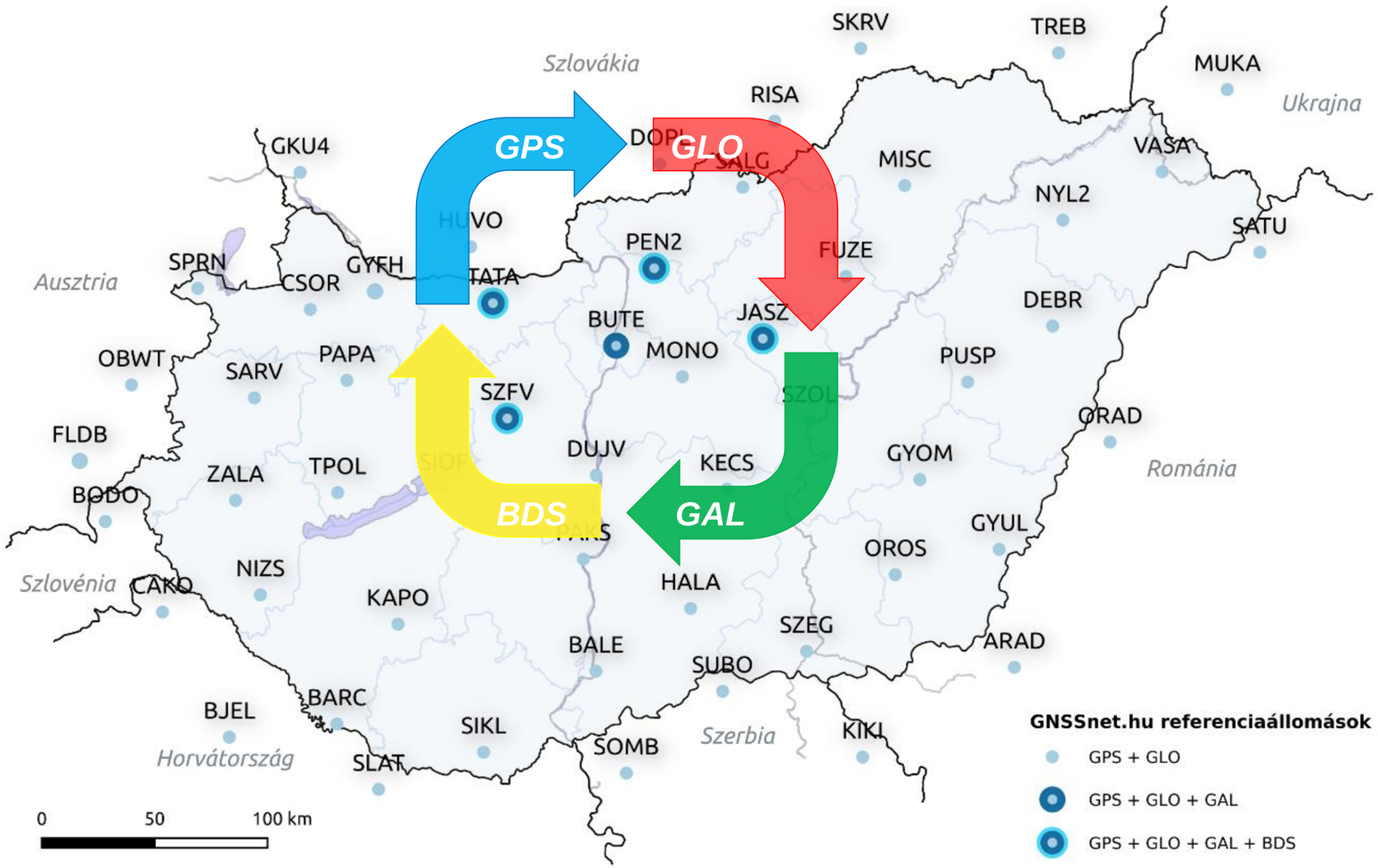
Modernization of the stations started and GNSMART-2 under testing



- *Four new Leica GR50 receiver + AR20 antenna installed*
- *But we need to modernize all stations!*

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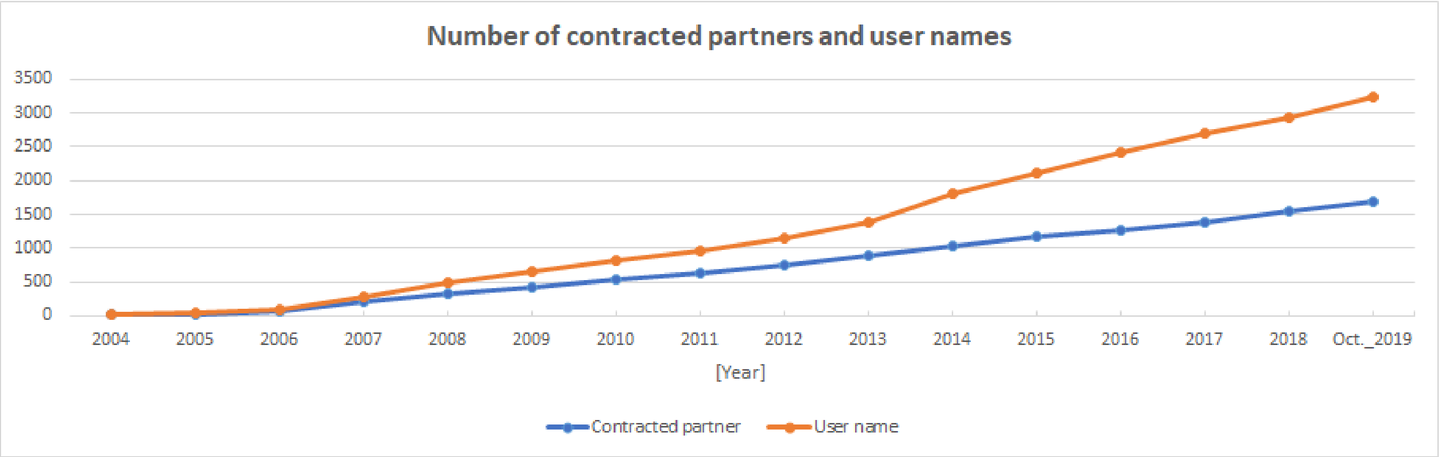
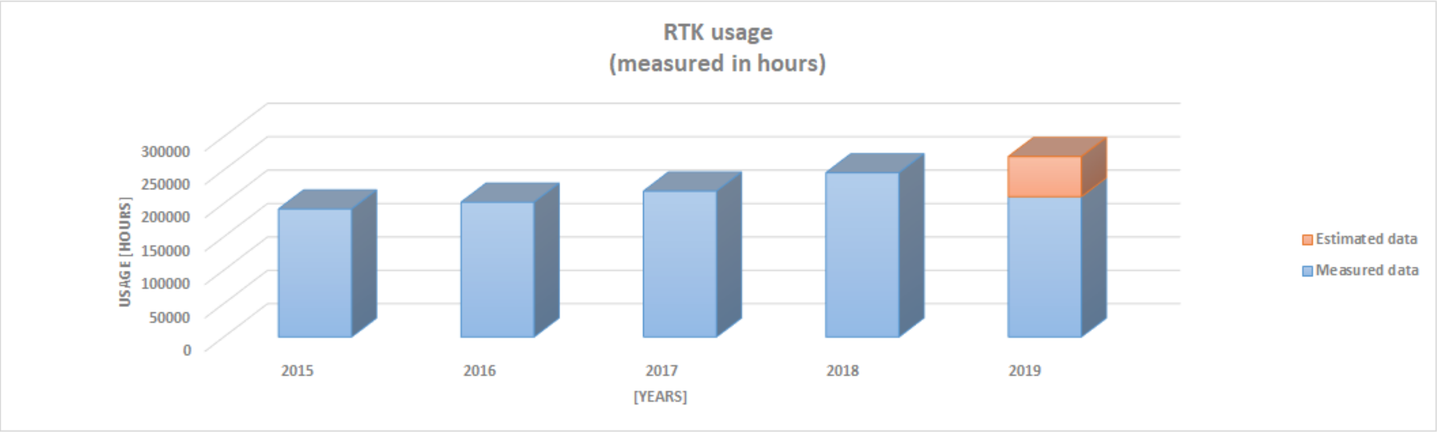
Statistics



Increasing number of users



Increasing usage time

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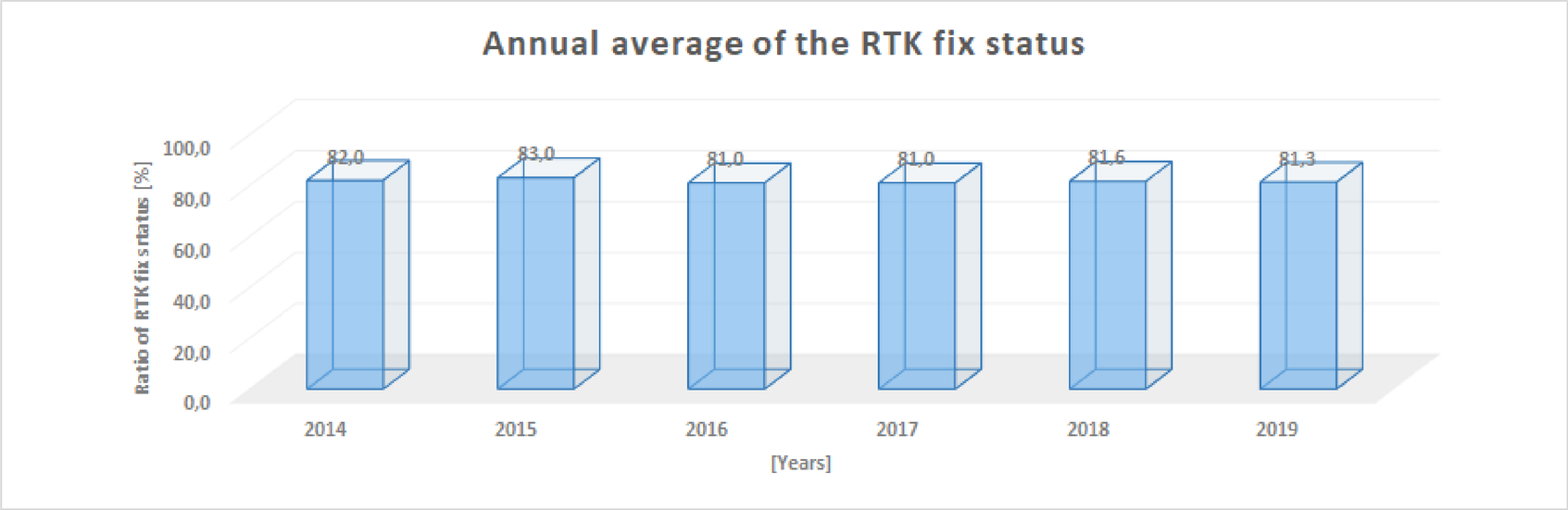
Annual average of RTK fix status at the same time



Approximately 81% - 82% over the years

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Service availability (measured in the official service time)

Stabil service for years, almost 100%

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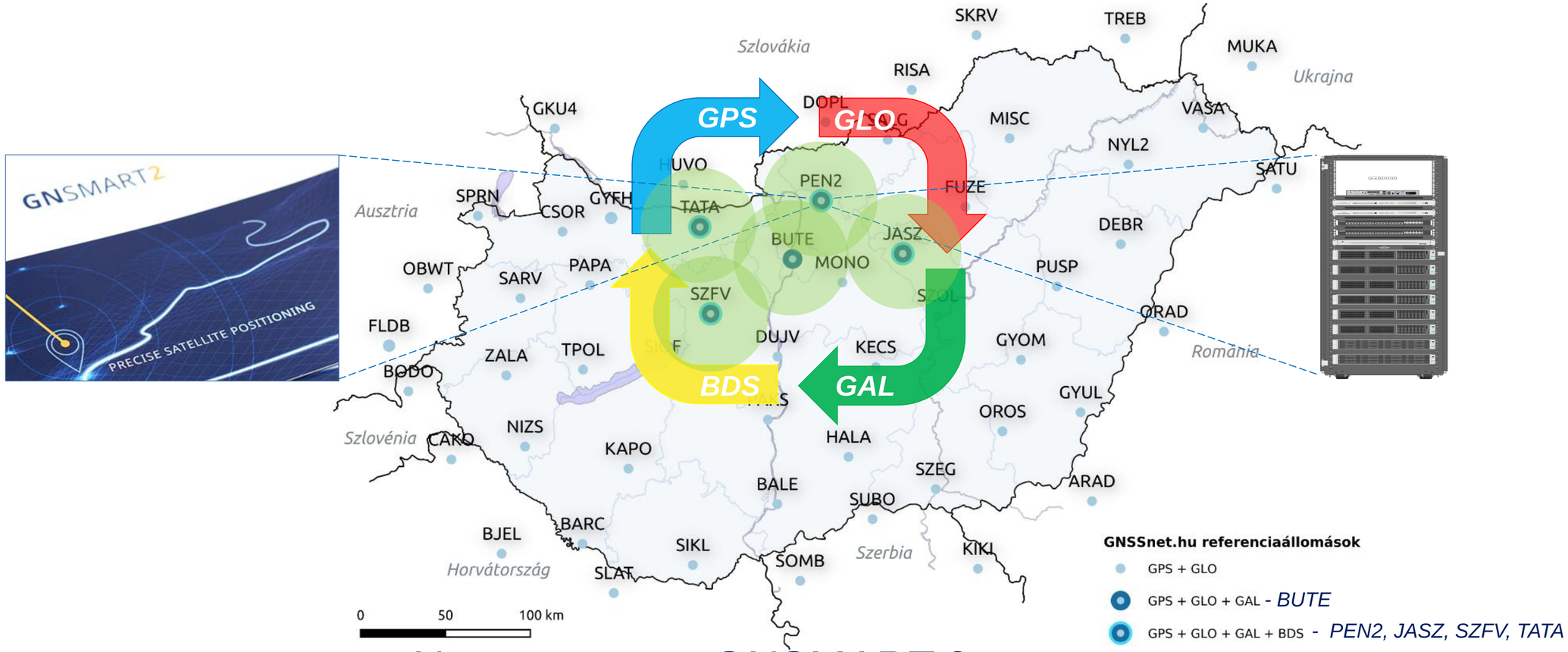
Test enviroment in SGO (Penc) for the multi navigation systems with the GNSMART-2



- *New servers + GNSMART-2*
- *Single base corrections from the Hungarian stations*
- *GPS+GLO+GAL+BDS from four stations*
- *GPS+GLO+GAL from BUTE*

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About the test measurements

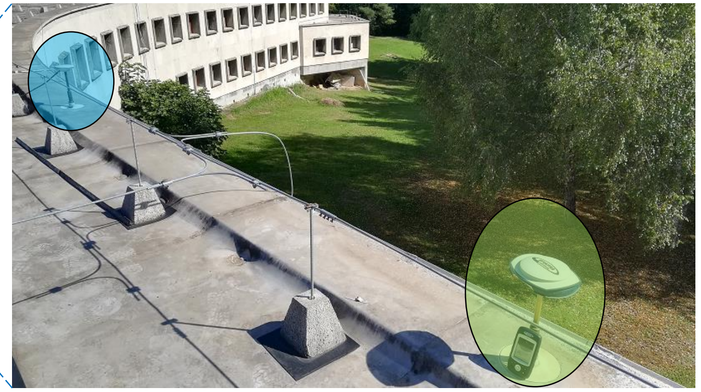
Goal of the test:

- *RTK positioning with different satellite systems*

(gaining experience about the Galileo and BeiDou navigation systems)

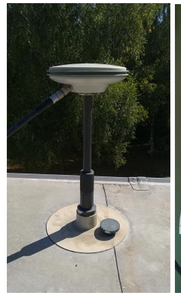
- *To compare the results to the GPS system*
- *To find the benefits of the multi satellite systems*

Real rover test in Penc at the roof the observatory



Using an old type of Leica rover *and* *a newer type of SP80 rover*

(only GPS) *(GPS+GLO+GAL+BDS)*



Conditions were almost the same

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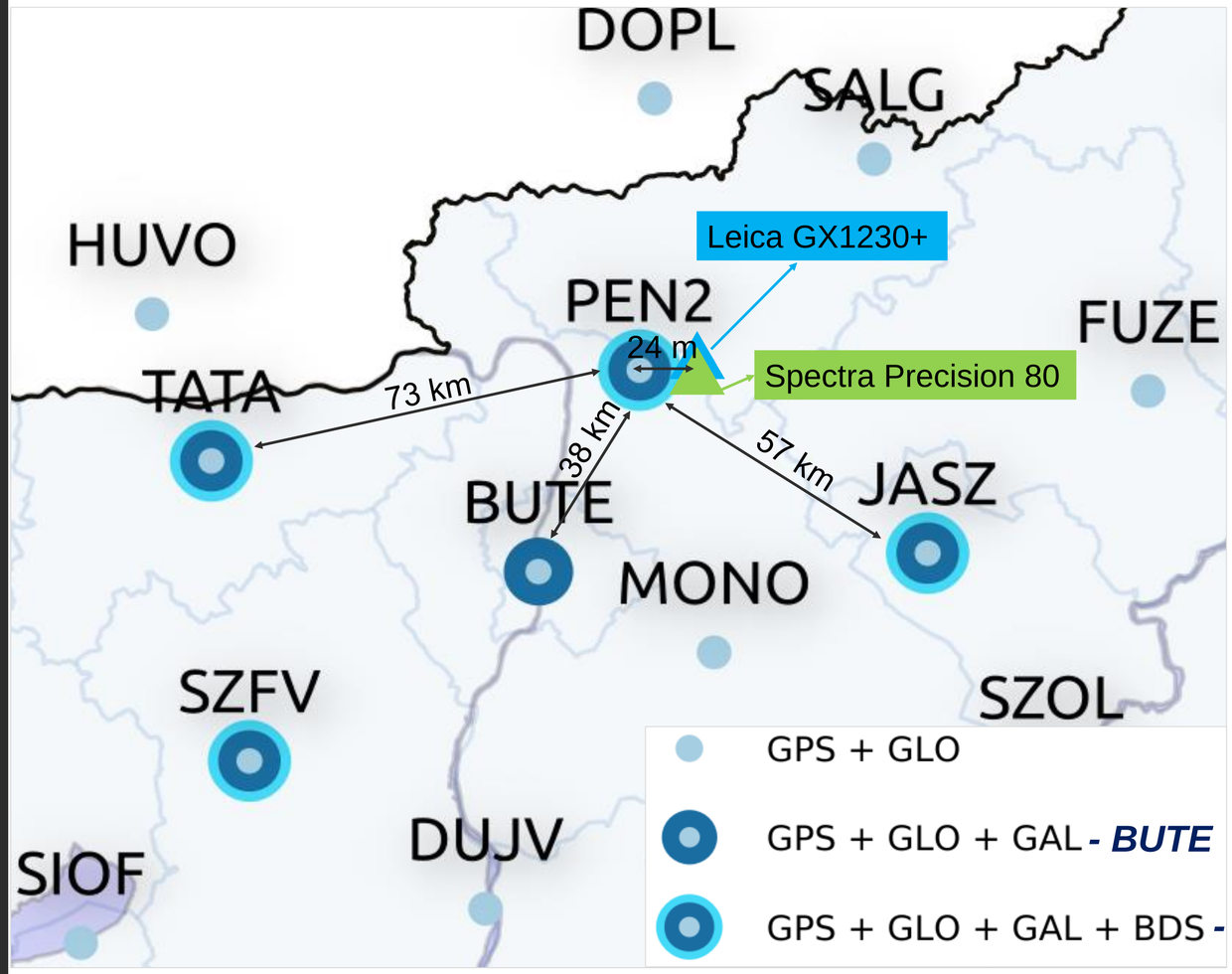
About the test measurements
Base distances from stations PEN2, BUTE, JASZ, TATA



	Leica GX1230+	Spectra Precision 80
Date	Sept. - Oct. 2019	
Location	Satellite Geodetic Observatory, Penc	
Measurement	Continuous single base RTK for about 4-7 hours	
Correction type	MSM4: **only GPS**	MSM4: **GPS+GLO+GAL** from **BUTE**; MSM4: **GPS+GLO+GAL+BDS** from **PEN2, JASZ, TATA**
Elevation mask	Basically: 30°	Between: 0° - 30° (Depends on the constellation and the positioning quality)
Data logging rate	5 sec.	

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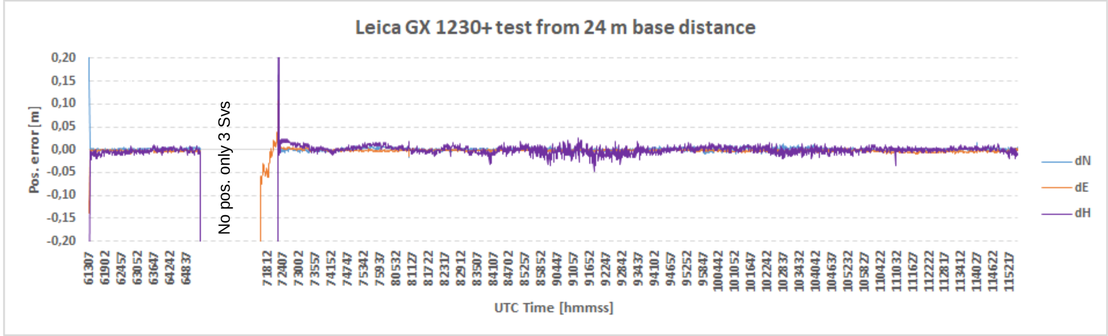
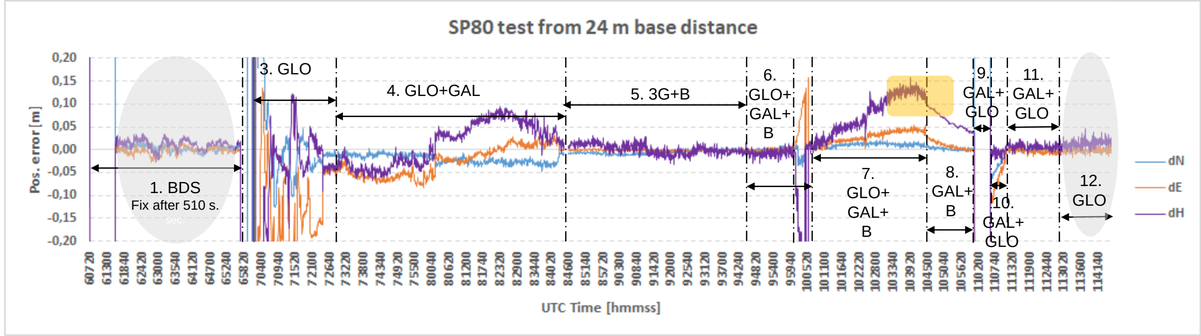
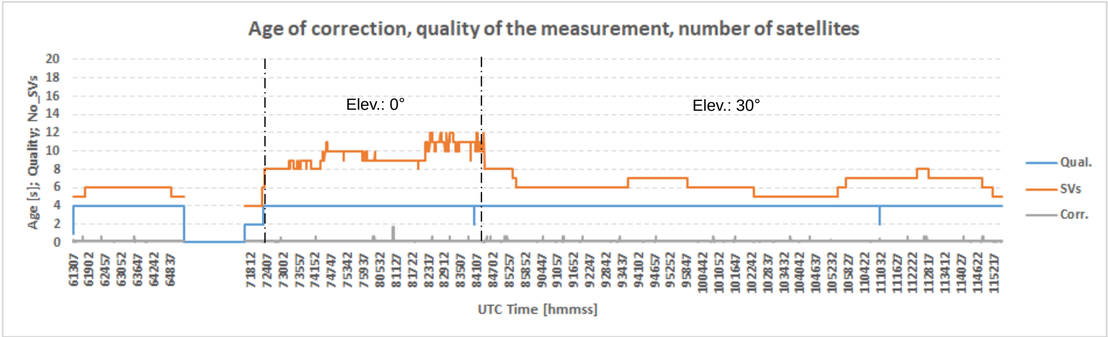
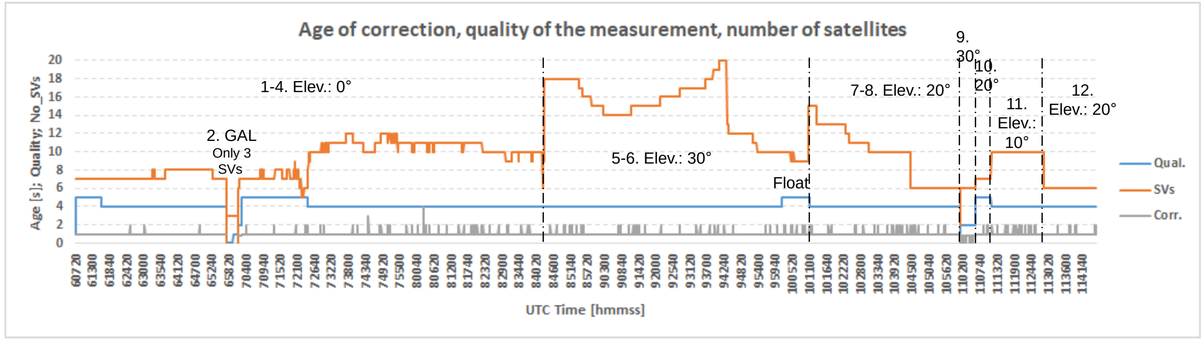
GNSS test measurements
From station PEN2 (base distance: 24 m)



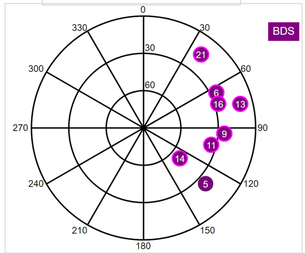






Perfect horizontal and vertical solution by Leica

1. HDOP:4.2!



Without GLO smoother height result

Fix quality only with BDS
Fix quality only with GLO

1. *Fix solution with BDS after 510 sec. (HDOP: 4.2)*
2. *GAL(5) SVs but only 3 SVs in used*
3. *GLO(7) SVs but no fix*
4. *GLO(7)+GAL(3) SVs, GAL helped but the precision not good*
5. *Perfect with GPS(8)+GLO(4)+GAL(2)+BDS(4) SVs*
6. *Perfect without GPS but later float*
7. *Elev.:20 ° less SV and worse precision (mainly dH)*
8. *Without GLO is getting better*
9. *Elev.:30 ° GAL(2)+GLO(4) SVs HDOP:3.3 only DGPS*
10. *Elev.:20 ° float with GAL(2)+GLO(5) SVS*
11. *Elev.:10 ° fix with GAL(3)+GLO(7) SVs, HDOP: 1.6*
12. *GLO(6) SVs fix*

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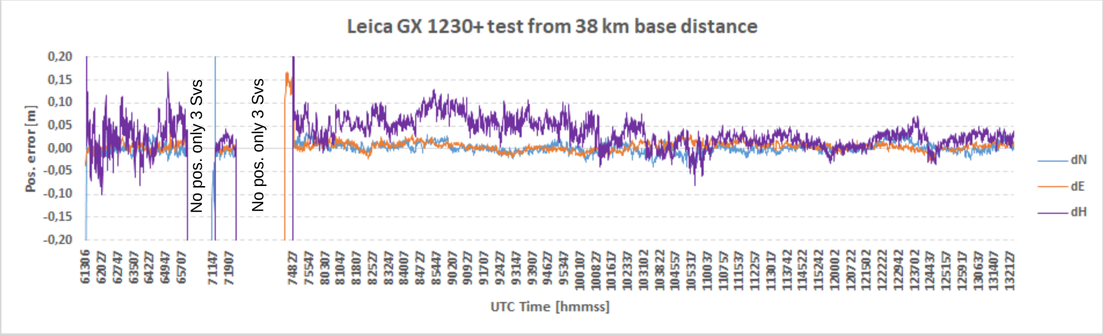
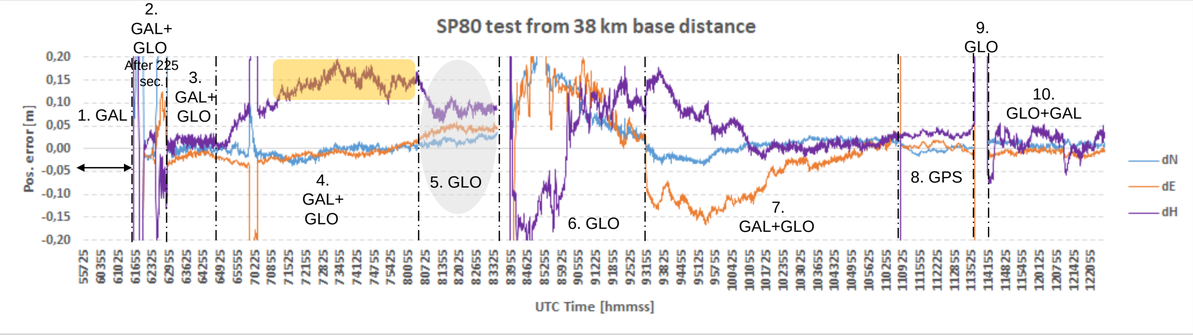
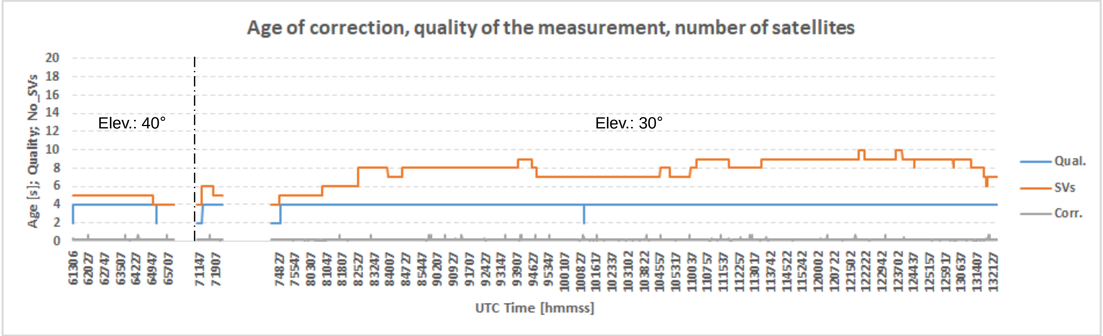
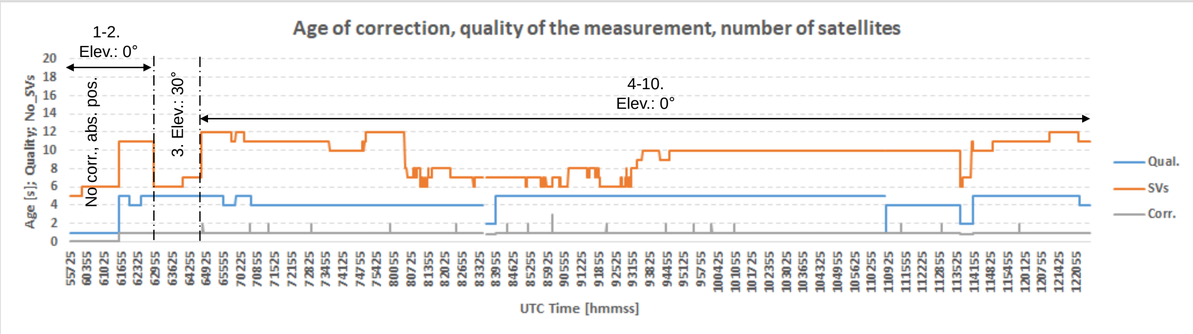
GNSS test measurements
From station BUTE (base distance: 38 km)









- *Horizontal components flawless*
- *Height component (purple colour) sometimes „poorer”*

Not acceptable dH result

Fix quality only with GLO

1. *The rover did not use the GAL correction alone*
2. *With GAL+GLO fix after 255 sec.but later float*
3. *Using less SVs (elev.: 30 °) no fix but good result*
4. *Elev.: 0 ° again mostly fix result but height component not precise*
5. *With only GLO dH getting better*
6. *After reinitialisation no fix with GLO*
7. *Even if GAL added [GLO(6)+GAL(2) SVs]*
8. *Only with GPS fix after 10 sec.*
9. *With GLO no fix*
10. *Added GAL fix after 40 min.*

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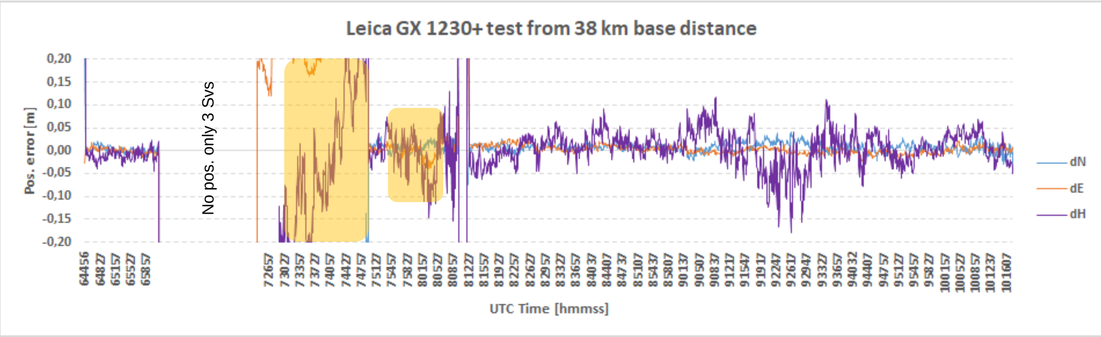
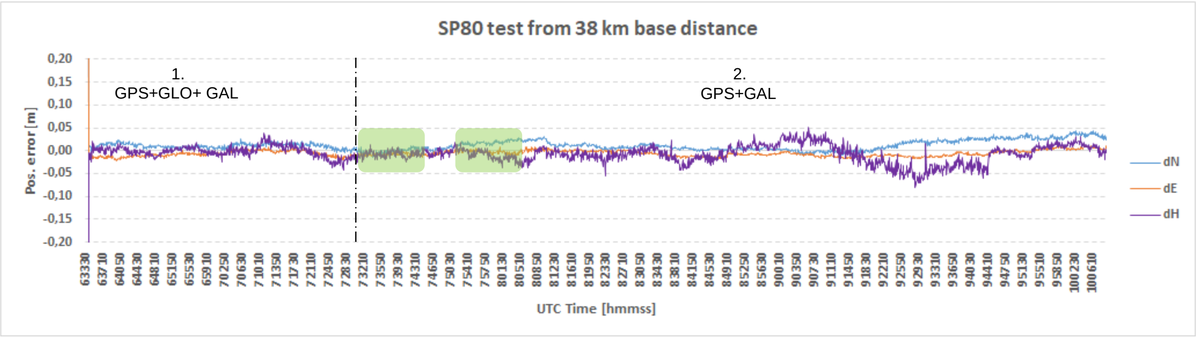
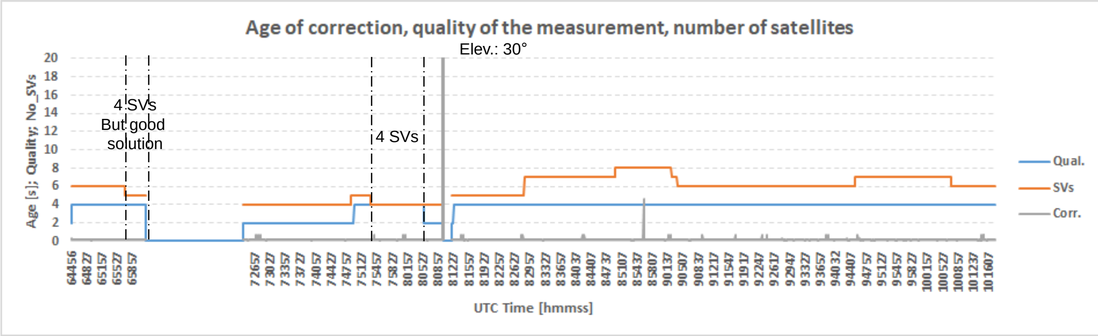
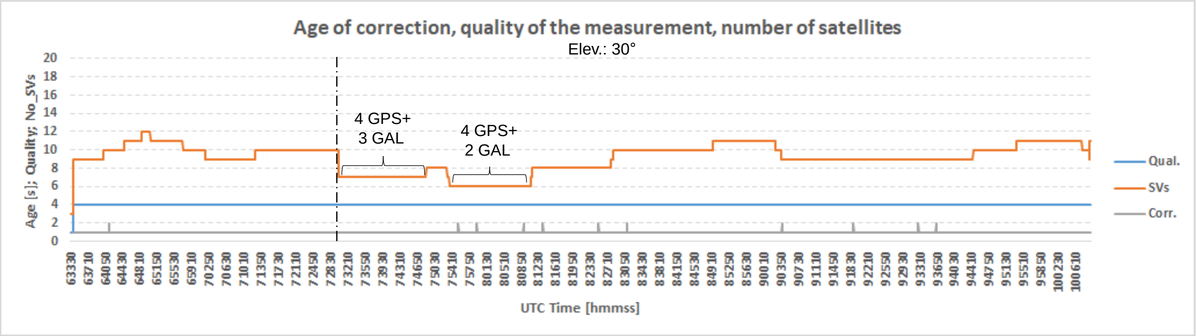
GNSS test measurements
Another day from station BUTE (base distance: 38 km)









- *Horizontal components are good*
- *Height component sometimes „weaker”*

1. *With GPS+GLO+GAL perfect solution*
2. *Using GPS+GAL show similar solution*

- *Without GAL no fix position with GPS(4) SVs by Leica*
- *Or if it fix the performance worse*
- *Than with GPS(4)+GAL(2) SVs by SP80, GAL helped*

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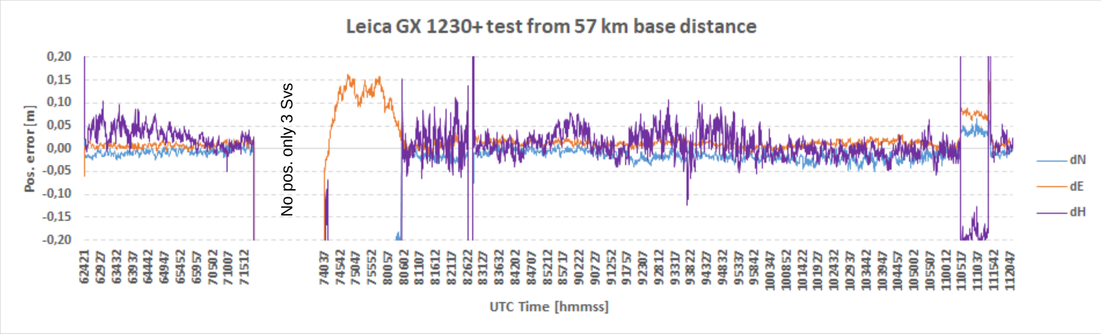
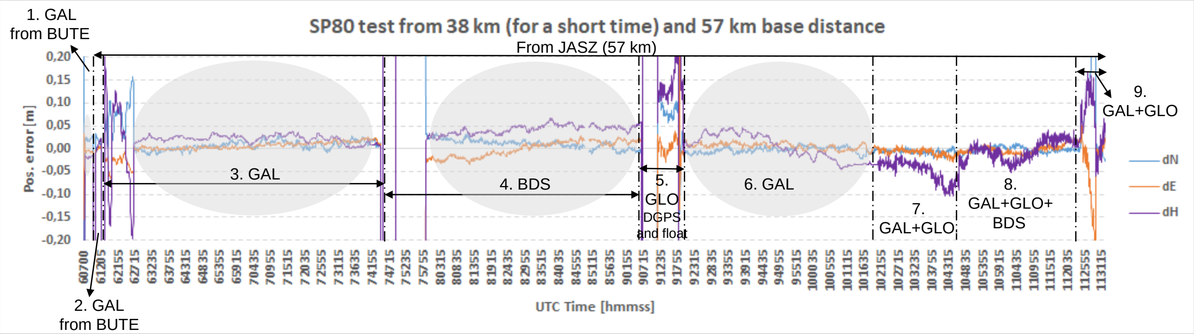
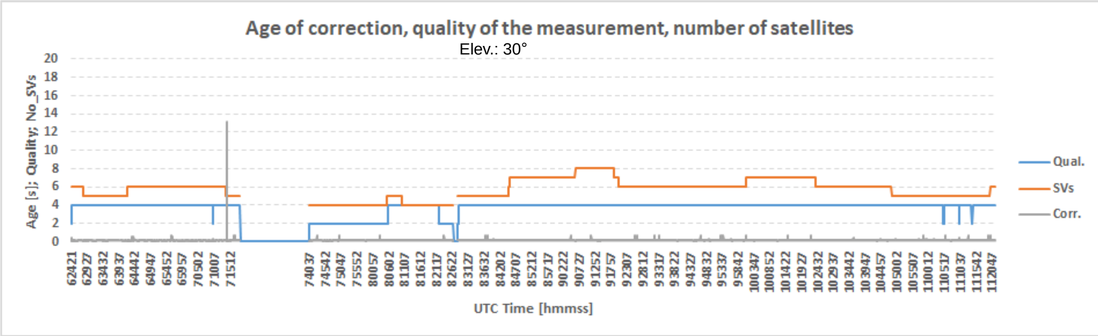
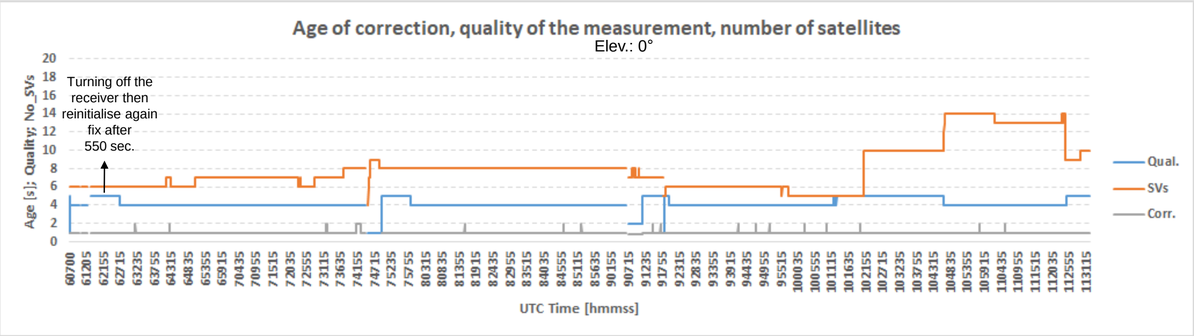
GNSS test measurements
From station JASZ (base distance: 57 km)









- *Horizontal components are good*
- *Height component sometimes „weaker” but the base-rover distance is too long*

- *Quick initialisation (10 sec.) with GAL from BUTE*
- *Fix quality with GAL and BDS from JASZ*

1. *From BUTE with GAL fix after 10 sec.*
2. *From JASZ with GAL hold the fix status*
3. *Turning off the receiver then reinitialisation again fix after 550 sec.*
4. *With BDS fix after 210 sec.*
5. *But with GLO only DGPS and float quality*
6. *Only with GAL fix position (after 90 sec.) and acceptable performance but end of the period float with 5 SVs*
7. *Adding GLO(5) SVs no fix*
8. *With GAL(4)+GLO(4)+BDS86) SVs fix again after 10 sec.*
9. *Without BDS float again*

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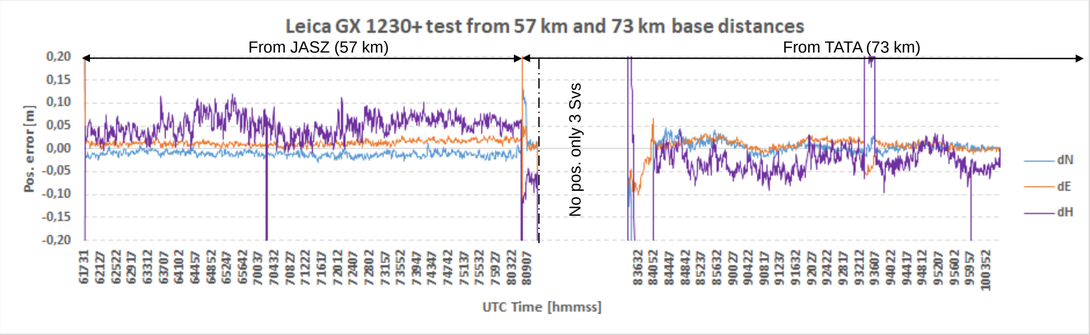
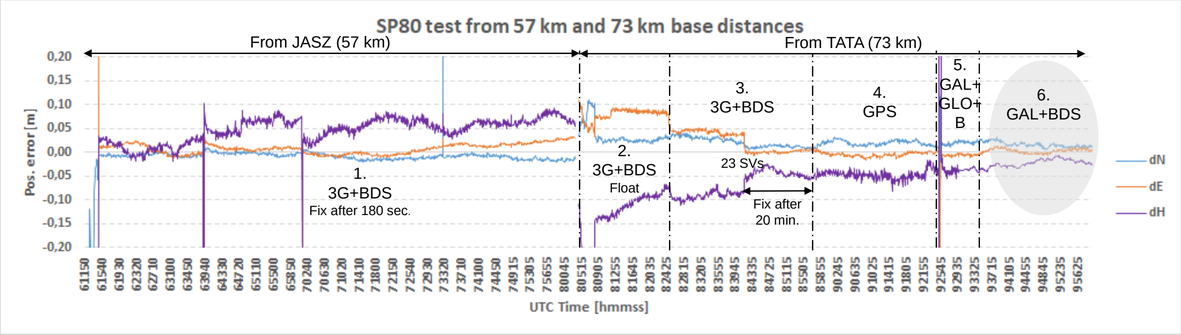
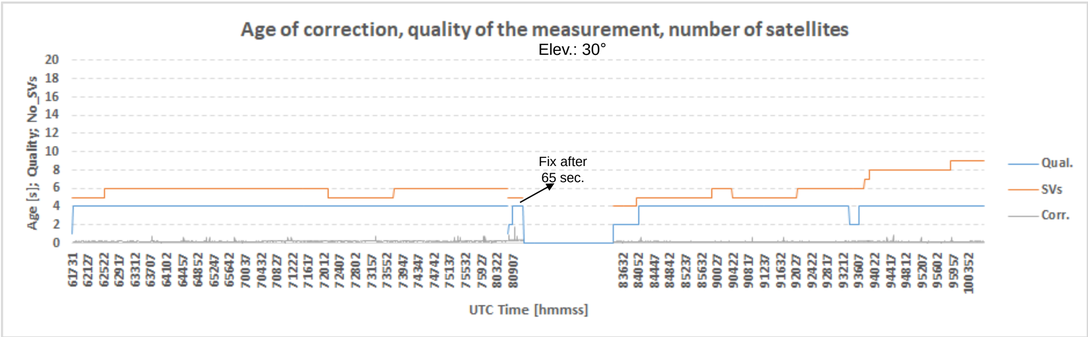
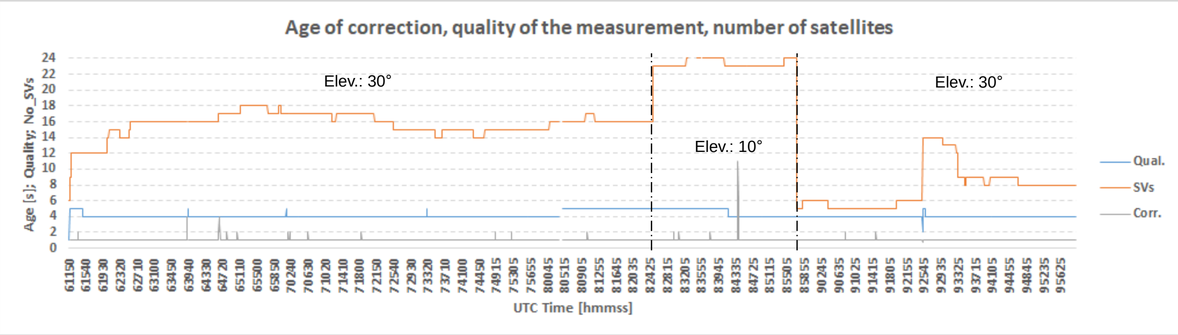
GNSS test measurements

From station JASZ and TATA (base distance: 57 km and 73 km)









The results are acceptable at such base distances by Leica

Fix quality with GAL+BDS

1. *Using GPS+GLO+GAL+BDS fix after 180 sec., dH is not perfect*
2. *Later became float with only GPS(4) SVs*
3. *Elev.: 10 ° , 23 SVs, fix after 20 min.*
4. *Elev.: 30 °, only with GPS the performance remained the same*
5. *With GLO+GAL+BDS was no change*
6. *With GAL+BDS got better*

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Some conclusion about my tests

RTK fix solution had been gained with all Satellite Navigation System separately

Galileo is able to support the positioning when it is needed

Basically GPS had shorter initialisaton time and still the strongest system

Of course for a general „judgement”, much more tests should be done!

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Thank you for your attention!

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